

# C M Y K



# Turning off the night

# A WAY HAS BEEN FOUND FOR THE TOMATO PLANT TO STAY UP FOR 24 HOURS, SAYS S ANANTHANARAYANAN

s the earth had formed with a pattern of day and night long before the appearance of life on the planet, most living things have evolved to survive best with a break of darkness between spells of light. Unlike animals, which grow and repair tissue during sleep in the night hours, the growth of plants takes place during the day in sunlight. What repair takes place during the night hours is not clear, but

it appears that extending the time of expo-sure to light could increase the growing hours of plants, including food plants. Aaron I Velez-Ramirez, Wim van Ieperen, Dick Vreugdenhil, Pieter MJA van Poppel, Ep Heuvelink and Frank F Millenaar, a group of scientifst working in the Natherlands report scientists working in the Netherlands, report in the journal *Nature Communications* that they have discovered a single genetic factor that enables some strains of the tomato plant to avoid adverse effects of being exposed to artificial light after sunset so that the grow-

ing hours extend through the night Increased production of tomatoes to the extent of 20 per cent, in some cases, has been

It is well known that during the summer months, when the length of the day is longer, vegetation flourishes more than during the winter, when the day is short. This is, of course, due to the fact that vegetation grows with se, due to the fact that vegetation grows with the help of photosynthesis, a process that needs sunlight. Farmers, at various stages, have tried to boost production, particularly in winter, by artificial lighting. The process is clearly expensive and not practical at a larger scale, but the trials have been extended to the stage of knowing plants expresed to light for stage of keeping plants exposed to light for the whole 24 hours

A peculiar result of such continuous expo sure to light, noticed in the 1920s with the domesticated varieties of the tomato plant, is that the plants develop leaf injury that can



The Netherlands group of scientists say they have discovered a single genetic factor that enables some strains of the tomato plant to avoid adverse effects of being exposed to artificial light after sunset so that the growing hours extend through the night. Increased production of tomatoes to the extent of 20 per cent, in some cases, has been reported.

per, lettuce and rose, and even thale cress regarded as a model plant organism for research, are not adversely affected by long hours of exposure to light. In fact, even wild varieties of tomato are resistant; it is the domesticated varieties that cannot tolerate continuous lighting. As the most important vegetable crop worldwide, as stated in the paper published by the Netherlands group, there has been an interest in finding why this is so, but with little success after eight

decades The Netherlands group report that they went into the genetic internals of the known wild tomato strains that were tolerant of Continuous Lighting and discovered that a particular gene, CAB-13, which gives rise to a protein that binds to light harvesting chlorophyll, was the major fact that brought about the tolerance. The study included a survey of tolerant types, their breeding, to show that tolerance was a dominant, as opposed to recessive, trait and a trial where CAB-13 was suppressed, leading to revival of adverse symptoms of CL. The tests "unequivocally indicate" that "CAB-13 plays a key role in the CL tolerance in tomato", the authors of the paper state.

kill them. Many other plants, including pep-

Further testing showed that tolerance to CL and exposure to CL conditions affected how the plant took in carbohydrates and also the pathway of photosynthesis – ie, the man-ner of production of food from sunlight. As higher levels of carbohydrates were found in CL-tolerant plants, too, this could not be the reason for injury to domesticated tomato plants. Tests also showed that the course of development or interaction with the environment of the plants was not affected by CL. In fact, it was found that even the daily rhythm of the plants, the circadian, or 24-hour clock. was not affected — flowers opened and closed in the morning or night — despite CL, which shows that the clock is running, adjusted perhaps by timing of temperature variation. As for pollination, bees were admitted to the plants only in the daytime and the cycle was unaffected. The level of photosynthesis, or fixing of carbon dioxide, with the release of oxygen, was also found to stay nearly unaf-fected in CL-tolerant plants. Overall, the yield of CL-tolerant tomato varieties was as good or better, rising to 20 per cent in some cases. It was also found that the gene for CL toler-

ance could easily be introduced in domestic varieties by crossbreeding with wild strains. And the trials have shown that tomatoes can be cultivated under CL, for the first time. The mechanism of the increased vield in CL



Velez-Ramirez at work

resistant strains is still not clear, as many factors are involved, but the identification of the gene responsible for CL tolerance is significant. This has now opened the way to more research into the nature of photosynthesis the mechanism of formation of carbohy drates, light signaling and the circadian clock.

The authors of the paper observe that the increase in yield up to 20 per cent shows that "the limitations for crop productivity, caused by the adaptation of plants to the terrestrial 24-hour day/night cycle, can be overcome". In this context, it is worth observing that for all the progress made, varieties of tomato that grow round the clock may not actually be cre-ated and used. A basic reason is that the extra production cannot be more than the energy input during the longer hours of exposure to light. The actual light used for illumination would always be much more than what is used by the plant.

Artificial light, during the night, moreover, is not free, as in the case of sunlight, but would come from electricity generated by burning fossil fuels, a process that is hardly efficient. Even with greater food demands as a result of a growing population, CL cultiva-tion for increased yield, and at the cost of further environmental damage, may not be an answer.

On the other hand, if an eco-friendly power supply, like stored solar energy, hydel or wind power is available, then CL cultivation could be viable. But the day that eco-friendly power for our existing needs and more, will be avail-able is not visible to the ordinarily sighted. The discovery of CAB-13, a breakthrough in photosynthesis research, may, hence, not directly benefit the tomato farmer.

THE WRITER CAN BE CONTACTED AT

# PLUS POINTS

## Avian evolution

Songbirds and fluffy chicks are known to be the descendants of monstrous dinosaurs, but exactly how certain lineages evolved into today's birds has been a mystery. A steady shrinking of one group, bipedal carnivores known as theropods, may have driven the dinosaur-bird transition, according to results published last week in Science.

An analysis of nearly 120 dinosaur species and more than 1,500 skeletal features revealed that the theropod lineages that are thought to have been direct ancestors of birds evolved skeletal adaptations four times faster than other dinosaurs. These avian ancestors consistently miniaturiSed over a 50-million year period, which likely facilitated the evolution of flight, and features such as skulls with shorter snouts, but bigger brains and eyes, the authors noted.

'What was impressive was the consistency of the size change along the dinosaur-to-bird transition, with every



descendant smaller than its ancestor according to study author Michael Lee of the South Australian Museum in Adelaide.

Tinier theropods may have found it easier to adapt to different resources — such as habitats or prey — than their larger kin. "It would have permitted them to chase insects, climb trees, leap and glide, and eventually develop powered flight," Lee said. "All of these activities would have led to novel new anatomical adaptations."

Lee and his coauthors identified 12 significant evolutionary time points during which theropods branched into different lineages. One key distinction they observed was when a group called Tetanurae evolved an angled thigh bone shifting their centre of gravity forward into the posture of modern birds. The change "paved the way for flight, and would not have been possible at a larger body size," Lee said.

"When you are small, it's a totally different ball game. You can fly and glide and I think that's what drove it," Paul Sereno of the University of Chicago, who was not involved in the work, said. He described the analysis as innovative and said the results were "key to what went on at the origin of birds'

### What's hotter?

You might be forgiven for thinking that when it comes to hot stuff you can't beat the surface of the sun but scientists have known for years that the surrounding atmosphere of a star is actually much, much hotter – and now they think they know why. While the visible surface of the sun, the photosphere, reaches temperatures of 6,000° Kelvin or 5,700° Celsius, the star's corona — the fluctuating area of plasma that extends millions of kilometres into space regularly exceeds heights of two million

Kelvin. "That's a bit of a puzzle," says Jeff Borsius, a space scientist with the University of Washington. "Things usually get cooler farther away from a hot source. When you're roasting a marshmallow, you move it closer to the fire to cook it, not farther away." New research published by him and his team in the Astrophysical Journal gives credence to the idea that a solar phenomenon known as nanoflares are responsible — extremely intense bursts of heat and energy that act like tiny heating elements in the surrounding plasma

In order to do so, nanoflares are thought



PLANT PROTECTION

TAPAN KUMAR MAITRA TALKS ABOUT THE BIOLOGICAL METHODS EMPLOYED

he biological method of protecting plants is based on use against pests, diseases and weeds of their natural enemies, as also various bacterial and fungal formulations that cause the mass extermination of harmful insects. This method of protection is very promising because it is virtually safe to humans and animals and, as a whole, to the environ-ment. For example, among the entomophags of harmful *Lepidoptera*, the egg parasite *Trichogramma* is widely used by the method of seasonal colonisation. The group of species and forms of parasites combined by this collective

etable, cotton and other crops, and also against corn horers heet webworms, pea and codling moths.

A substantial recent achievement was the develop-ment of an industrial technology for breeding the Trichogramma. On the basis of this technology, the All-Union Institute of

Plant Protection and the production organization, Agropribor, developed an experimental automated biological factory. At present, over 50 biological factories have been set up with a total output of over 50,000 million specimens during a ingle season. In addition to the *Trichogramma*, widespread tions are available on the market for controlling harmful *Lepidoptera* — entobacterin and dendrobacillin. The former is used against the cab bage and small white butterflies, diamond back and apple moths, pierid butterflies, brown-tail fruit-tree tortrix, and fall web-worm moths. Dendrobacillin, in addition to the pests mentioned above, is effective against bollworms and

conducted of the new bacterial formulation bitoxybacillin, developed on the basis of the Bacillus thuringiensis var. thuringiensis at the AU-Union Research Institute of Agriculturl

ame is used for controlling turnip moths and cutworms on cere-al, sugar beet, veg-Entomo Phytopathogens pathogens (Fungi, Bacteria) (Phytoplasma) Antagonists (predators, Herbivores Cultivated parasitoids. (vector insects) Plant microbes)

Microbiology. Bitoxybacillin is toxic to the lar

vae of the Colorado beetle, the alfalfa

Η

army-worms. Widespread field tests are successfully being How horses communicate THE MESSAGES ARE NOT STRAIGHT FROM THE EQUINE'S MOUTH  $\sim$  ONLY ITS EYES AND EARS, WRITES STEVE CONNOR

orses have more sense than many people realise, according to scientists who have shown they are able to communicate with one another by moving their eyes as well as their ears. A study has found that domestic horses are aware of the direction in which other horses are concentrating by looking at the gaze of their eyes and the posi-tion in which their mobile ears are pointing. Other animals, such as monkeys and apes with forward-pointing eyes are also known with forward-pointing eyes, are also known to follow the gaze of other individuals but this is the first time researchers have shown that the ability is shared by a "prey" species with eyes on the sides of its head, the scien-tists said. It is also the first time researchers have shown that animals with wiggly ears are able to use these movements to see what are able to use these movements to see what it is another individual is concentrating on, said Jennifer Wathan of the University of Sussex, who carried out the research with her PhD supervisor, Karen McComb. "Our study is the first to examine a poten-

tial cue to attention that humans do not have — the ears. Previous work investigating com-munication of attention in animals has focused on cues that human use (such as) head orientation and eye gaze," Wathan said. "However, we found that in horses their ear position was also a crucial visual signal that other horses respond to. In fact, horses need to see the detailed facial features of both eyes and ears before they use another horse's head direction to guide them.

results provide the first evidence from an animal with laterally placed eyes that cues from this area convey important information," the scientists say in their scientific paper published in the journal *Current Biology*. "Most significantly, our results demonstrate that animals with large, mobile ears can use these as visual cue to attention. The potential role of the ears in signalling has been overlooked in previous experiments."

The researchers presented a horse with a choice of two buckets containing the same type of tasty food, but deliberately placed a headshot of another horse so that it looked as if it was concentrating on only one of the two buckets. When the photograph showed a horse without any mask, it had a significant effect on the choice of bucket taken by the test horse. However, the photograph had no discernible effect when it showed a picture of a horse with either its eyes or ears covered.

and we humans are particularly good at it, helped by the white sclera of the eye and the prominent brow ridges," Wathan said. "Being able to follow the attention of another horse is really a fundamental skill and in the wild can inform you of an advancing preda tor or the location of a high-value food source.

"Horses use their facial cues to understand the environment around them, so it is com-

the study found. "We see the ability of following another individual's gaze in a wide range of species,

use is made of a method of seasonal colo nisation of the predatory mite *Phytoseiulus per-simila* to control spider mites on vegetable and decorative crops in sheltered soil. The use of this predator made it possible to sharply reduce and, in many cases, to completely exclude the use of acaricides on the basic greenhouse crop - cucumbers. The yield from one square metre grows, on an average, by one-five kilograms in comparison with the use of acaricides.

To control aphids on cucumbers in greenhouses, the predatory gan midge aphidomiza is used. The simultaneous employment of the Phytoseiulus persimilis and the aphidomiza makes it possible to do without treatments with insectoacaricides. The integrated protection of cucumbers is

supplemented by the use against powdery mildew of the biological formulation trichothe-cin, which has no negative effect on the *Phytoseiulus persimilis* The wooly aphid parasites (*Aphelinus mali*), introduced in the '30s, inhibit the reproduction of the wooly apple aphid very well. The specialised predator of the fluted scale, the rodolia (Rodolia cardinalis Muls) has become acclimatised.

The use of microbiological means of plant protection has expanded. Two bacterial formula-



To control mouse-like rodents (*Muridae*), great favour is given to the bacterial formulation bac*torodencide*, prepared in two forms — dry grains and dry amino-bone. Among the fungal formula-tions, *beauverin*, proposed by the Scientific Research Institute of Plant Protection on the basis of the *Beauveria bassiana* (Bals.), has passed state tests and may be used to control the Colorado beetle. A formulation prepared on the hasis of fungi of the genus Asherso-nig has been tested against the greenhouse whitefly on veg-etable crops and has shown good results.

Pilot lots of phytobacteriomycine are being produced that is effective against bacterioses of beans and soya and against root rots of wheat. The effectiveness of *tricho-dermin*, prepared on the basis of the soil fungus-antagonist *Tricho* derma lignorum (Harr), is being studied. The fungus produces a number of antibiotics with antibacterial and antifungal properties.

*Trichodermin* has shown good results against cotton wilt, wheat and cucumber root rots, sunflower and corn collar rot and carrot black rot Broomrapes are being controlled with success by using the leaf-miner phytomyza (*Phytomyza* orabanchia Kalt).

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The study used full-size photographs of horses' heads to see if equine facial features could influence the attention of another horse. The photographs were of a model and without a facial mask that with covered either their eyes or their ears. "Our

munication in one sense. They may not need to understand why they are following anoth er horse's gaze. It can be a simple trigger, she added.

THE INDEPENDENT



Horses are believed to use their eyes and ears to direct others to sources of food, research has found.

shows a 200,000-mile long solar filament ripping through the sun's corona in September 2013.

> reach temperatures of 10 millior Kelvin, Unfortunately, this means the resulting solar event is so short-lived and small that scientists can't observe them directly - instead, they have to rely on measuring wavelengths of light emitted at those temperatures. This is exactly what Brosius and his

team have done, scanning a particularly active region of the Sun using a relatively rough-and-ready spacecraft known as a sounding rocket. These are launched into Space for 15 minutes at a time, reaching heights of around 200 miles before falling back to earth. This type of mission produces just six minutes of observational data, but this proved enough for Brosius and his team. The craft they launched in April last year came back with data described as the nanoflares' "smoking gun", a spectral emission corresponding to material heated to 10 million degrees. "This (...) really gives us the strongest evidence yet for the presence of nanoflares." he said. "The fact that we were able to resolve this emission line so clearly from its neighbours is what makes spectroscopists like me stay awake at night with excitement."









